

REMARKS

Summary

By this Amendment, Claims 1-14 have been canceled in favor of new Claims 15-26.

Accordingly, Claims 15-26 are now pending in the application.

Election/Restriction

New independent Claim 15, and dependent Claims 16, 21, 22 and 24, correspond to both the elected species "B" (single atomic oxide) and the non-elected species "C" (composite oxide).

New dependent Claims 17, 18, 19, 23 and 25 correspond to the elected species "B".

New dependent Claims 20 and 26 correspond to the non-elected species "C", and accordingly, it is expected that these claims will be withdrawn from consideration.

35 U.S.C. ¶112

The phrase "major components" no longer appears in the claims of the application, and accordingly, it is believed that the rejections based on 35 U.S.C. ¶112, first and second paragraphs, have been overcome.

35 U.S.C. ¶102

Claims 1, 3-6 and 8 were rejected under 35 U.S.C. ¶102 as being anticipated by Comizzoli et al. for the reasons stated at pages 3-5 of the Office Action. Applicants request reconsideration of this rejection with respect to the now-pending Claims 15-26.

As recited in independent Claim 15, an oxide film is formed on the surface of a silicon substrate by first flushing the surface of the substrate with oxygen so as to uniformly terminate dangling bonds on the surface with oxygen atoms. Thereafter, first and second reactants are introduced into the chamber to form a film of oxide material, where the oxide material includes the oxygen atoms used to terminate the surface of the substrate.

Comizzoli et al. teaches formation of an oxide film (Al_2O_3) by introduction of reactants (TMA and water) into a reaction chamber. However, Comizzoli et al. does not teach first flushing the surface of the substrate with oxygen so as to uniformly terminate dangling bonds on the surface with oxygen atoms which are later included in the oxide film. Rather, Comizzoli et al. teaches purging the chamber with nitrogen prior to introduction of reactants. (Col. 6, lines 25-36.)

For at least these reasons, Applicants respectfully contend that Claim 15, and the Claims 16-26 dependent thereon, are not anticipated by Comizzoli et al.

35 U.S.C. ¶103

Claims 1-3, 5-9 and 11 were rejected under 35 U.S.C. ¶103 as being anticipated by Kim et al. in view of Marcus et al. for the reasons stated at pages 5-7 of the Office Action. Applicants request reconsideration of this rejection with respect to the now-pending Claims 15-26.

As noted above, according to independent Claim 15, an oxide film is formed on the surface of a silicon substrate by first flushing the surface of the substrate with oxygen so as to uniformly terminate dangling bonds on the surface with oxygen atoms. Thereafter, first and second reactants are introduced into the chamber to form a film of oxide material, where the oxide material includes the oxygen atoms used to terminate the surface of the substrate.

The Examiner acknowledges that Kim et al. does not teach termination of the substrate surface with oxygen, and that instead the surface of the substrate of Kim et al. is terminated with hydrogen prior to formation of the Al_2O_3 films. However, the Examiner contends that it would be obvious to modify Kim et al. to terminate the substrate surface with oxygen instead of hydrogen in view of the teachings of Marcus et al. Applicants respectfully disagree.

Kim et al. teaches pretreatment of the substrate surface so as to remove particles and native oxides by chemical treatment and etching using hydrofluoric

acid (HF). This cleaning treatment results in the substrate surface being terminated with hydrogen. In particular, Kim et al. states:

“Prior to the growth of Al₂O₃ films, the native oxide covered substrate, Si(100), was cleaned by the conventional wet chemical treatment and diluted HF etching treatment in sequence for the removal of particles and native oxides, respectively. The surface of the Si prepared in this manner is known to be contamination-free and terminated with atomic hydrogen.” (Emphasis added.)

Accordingly, an objective of the pretreatment of Kim et al. is to remove oxides. Further, the termination of the Si surface with atomic hydrogen is a by-product of the etching process using HF.

It is not apparent to Applicants how Kim et al. might be modified to etch the surface of the silicon substrate to remove particles and oxides, such that the resultant surface is instead terminated with oxygen.

Accordingly, Applicants respectfully contend that one of ordinary skill would not apply the teaching of Marcus et al. to the teachings of Kim et al. in the fashion suggested by the Examiner.

Further, Applicants respectfully disagree with the Examiner’s apparent contention that Marcus et al. broadly teaches the “equivalence of hydrogen-

terminated and oxygen-terminated substrates for film growth” in the context of the process of Kim et al.

Marcus et al. is directed to utilizing a directed energy beam to selectively deposit material from a gas phase or selectively evaporate material condensed from a gas phase. Marcus et al. teaches that termination of the substrate surface with atomic-hydrogen or oxygen is one of several options in conducting an “initial nucleation process of adding material onto the virgin target area or substrate.” Other options include depositing a powder of SiC and NaCl or depositing a thin layer of hydro-carbon material. Marcus et al. states that it “is understood that nucleation, as defined herein, is the conditions under which the laser interacting with the substrate promotes the decomposition of the gas phase and creates a deposit of one material of critical size on the existing surface.” (Col. 15, lines 22, through col. 16, line 2.)

It would not be obvious to modify Kim et al. to deposit an “initial nucleation promoter” (whether a SiC and NaCl powder, an atomic-hydrogen or oxygen termination, a hydro-carbon film, etc.) as in Marcus et al.

For at least the reasons stated above, Applicants respectfully contend that Claims 15-16 would not have been obvious to one of ordinary skill in art in view of the teachings of the cited references, taken individually or in combination.

Conclusion

No other issues remaining, reconsideration and favorable action upon the
Claims 15-26 now-pending in the application are requested.

Respectfully submitted,

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